

The nutritional status at six months is not associated to 6-24 month child mortality in the supplementation context: Case control matched study from rural area of Burkina Faso.

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Abstract

Background: The death of children is a good indicator of health level and social development of country. In the context of food supplementation, the factors associated with child death remain little known.

Objective: We examined the relation between nutritional status and child mortality in the context of food supplementation in rural area.

Methods: We conducted matched case-control study nested in a cohort of child mother-pairs followed in the context of food supplementation. Conditional logistic regression was used to examine relation between nutritional status and child death. A significance level of 0.05 was considered significant. We use diagram causal model to identified variables for regression.

Results: A total of 104 deaths and 208 controls were included in the study. The mean age of mothers was 26.13 ± 6 years. The only factor associated with univariate and multivariate analysis in the model used was the age of the mothers. In univariate, deceased children were 54% less likely to be born to mothers aged 20 to 34 compared to children born to mothers under 20 years of age (OR=0.46, 95% CI=[0.23-0.91] and P=0.027). The nutritional status of children, socio-economic status, birth season, vaccinal status, and twins were not associated with the death of children in multivariate analysis.

Conclusion: Nutritional status is not associated at child death in the context of food supplementation. Supplementation would therefore reduce the deaths of malnourished children.

Keywords: Children deaths 6-24 months, Nutritional status, Food supplementation, Burkina Faso.

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Introduction

In 2015, according to the World Health Organization (WHO), 4.5 million (75% of all under-five deaths) of deaths occurred in the first year of life. The risk of a child dying before his fifth birthday is 8 times higher in the WHO African Region than in the European Region [1]. Substantial global progress has been made in reducing child mortality since 1990. The number of deaths of children under five decreased from 12.7 (CI:12.6-13.0) in 1990 to 5.9 (CI:5.7-6.4) millions in 2015. The number of deaths in one day rose from 35,000 in 1990 to 16,000 in 1990 [1], a decrease of 54%.

According to the United Nations Children's Fund (UNICEF), in the area of children's rights in terms of survival and development, the part is far from won for the poorest and most disadvantaged families. The fact that child is less likely to survive or to be in good health because of circumstances related to his birth is flagrant injustice and violation of his rights. It also represents a human, economic, social and politics costs [2]. In the same report, neonatal deaths accounted for 45% of

all deaths in 2015, a proportional increase of 5% over 2000. The increasing share of deaths in the neonatal period illustrates the faster decline in children aged 1 to 59 months than of newborn's [2].

Sub-Saharan Africa, while having the highest mortality rate among children under five in the world, is also declining considerably. The annual reduction rate increased from 1.6 percent in the 1990s to 4.1 percent from 2000 to 2015 [3]. Thus, by 2030, the Sustainable Development Goals (SDGs) set as objective 3.2 to eliminate preventable deaths of newborn's and children under 5, all countries seeking to reduce neonatal mortality at 12 per 1,000 live births at most and under-five mortality at 25 per 1,000 live births at most [4]. Mosley and Chen developed the theoretical model of five groups of determinants of health. This approach shows how five groups of proximate determinants influence child survival in developing countries. Immediate determinants are grouped into five categories: maternal factors, environmental pollution, nutrient deficiencies, injuries, and personal control of the disease (prevention, treatment) [5].

Several other studies have shown a significant relationship between infant mortality and parents' educational level, maternal age during first pregnancy, prematurity, low birth weight, and type of delivery and pregnancy exclusive breastfeeding [6-10]. The solutions to reduce child mortality are based on interventions that are part of the improvement of maternal and child health, the fight against malnutrition, the increase of the socioeconomic level [11-13].

As the literature shows, there has been much research into the factors associated with the death of children under five [14]. All of these studies focus on neonatal and perinatal deaths [15-23]. There is clearly a gap in research on the factors associated with the death of children aged 6 to 24 months in a context of food supplementation. While starting at 6 months, breastfeeding is no longer enough to cover the child's needs and the introduction of supplement foods and weaning preparations have an impact on the child's survival.

From July 2014 to September 2016, a cohort of children received nutritional supplementation with a nutritional education of mothers as part of the prevention of malnutrition and the improvement of maternal and child health. In this intervention the deaths of children from 6 to 24 months were not included as a criterion for judgment. To fill this gap in order to guide future interventions to reduce the deaths of children under five, this research project aims to examine the relation between nutritional status with the death of children in the 6 to 24 month age range in a context of nutritional supplementation and nutritional education of mothers in rural Burkina Faso.

Methods

Study context

The study was conducted in the north-central region in rural area in four rural communes. In these four communes, the Vim Project is supplementing a cohort of children. The goal of the intervention was to reduce chronic and acute malnutrition in children under five and pregnant women. Implementation of the intervention is done using food distribution points offering dietary supplements in four different arms (CSB14, CSB+, RUSF, SC+) to children aged 6 to 24 months. Also from the first trimester of pregnancy, women receive a ration during pregnancy and ration during breastfeeding. In total 199 villages in the four municipalities (Kaya, Pissila, Namissigma, and Barsalogo) are concerned by the intervention. In addition to supplementing children, nutritional and health education for mothers in group sessions at distribution sites was conducted. In this intervention the deaths of children from 6 to 24 months were not included as a criterion for judgment.

- Ration pregnant woman (Pea + enriched vegetable oil)
 - Ration breastfeeding woman (Pea + enriched vegetable oil)
 - Ration children from 6 to 24 months: 04 different arms
- 1) Boiled flour made from a mixture of corn-soya 14 (CSB14) (with a protein concentrate of milk and a higher micronutrient content), prepared with enriched vegetable oil (FVO); 75g CSB14/day, 22.5g FVO/day
 - 2) Ready-to-use food supplement 1(RUSF1); (100g RUSF/day 3)

- 3) Super Cereal Plus (SC+) flour-based porridge (has an increased micronutrient content, skim milk powder, and the oil already contained in CSB); 122g SC+/day
- 4) Flour made from a corn-soy blend Plus (CSB+) made with enriched vegetable oil (FVO); 75g CSB+/day, 22.5g FVO/day

Study period and study type

This is matched case-control study nested in a cohort from August 2014 to December 2016. The collection of additional retrospective data was carried out from May 15 to June 15, 2017.

Study population and sampling

The study population consisted of child mother-pairs (person in charge of the child) from 06 to 24 months of the intervention zone.

Sampling, data collection and recruitment

All cases of death from 31 August 2014 to 1 December 2016 of the cohort were included in the study. A total of 110 deaths were recorded in the cohort. A check was made with the household to ensure that the death occurred. Using GPS coordinates, home-based indications, names of heads of households and concessions, and the names of the caretakers in the files, we visited households to effectively contact the deaths of children. But we could not have children's death certificates. Thus out of the 110 deaths recorded in the cohort, we were able to confirm 104 deaths (with those in charge of the child) that were actually considered as the cases in this study. Each death case was matched to two children from the same village as a control. The 06 cases were child name errors. The first control was female and the second was male. These controls were randomly drawn for each death in a village among the same-age surviving children in the village. A list of children of the same ages and gender was drawn up by village. If there are more than two children of the same age and sex, we drew lots of both controls.

An investigator trained under our supervision was in charge of collecting the additional data. A data collection sheet has been developed. The questionnaire was sent to the person in charge of the child. Anthropometric data and morbidity during the last two weeks when the child was 6 months of age were reported from the cohort tracking database. Anthropometric data at 06 months were collected by team of 04 peoples with a supervisor. A Salter scale was used for the measurements of the weight and the size was measured in supine position. The branchial perimeter was measured using the Shakir strip.

Calculation of sample size needed

The sample size was calculated by choosing a proportion of the controls exposed in 30%. Using power of 80%, a level significance $\alpha=5\%$, and an Odd Ratio=2 and one case for two controls, we estimate that we need 104 cases. With OR=2, we will have a proportion of the exposures of 0.45%. The size of our sample is therefore $104+2*104=312$ mother couples children

Measures

Child status: Deaths for cases and Living for controls.

Nutritional status: Normal, malnourished

Co-variants:

- Characteristics of the child: vaccine status, season of birth, number of children at birth.
- Characteristics of the mother: level of education, age.
- Socio-demographic characteristics of the household: Household ownership and household characteristics (water sources, latrine presence), family environment (level of education of head of household, number of children under 05), the socio-economic level of the household, the main type of latrine in the household, the main source of drinking water in the household, the size of the household.

Data Analysis

The data was entered with the Epi-data 3.1 software and analyzed with the Stata version 14 software. A significance level of 0.05 was considered significant.

The relevant explanatory variables to be studied have been selected. We use diagram causal model to identified variables for regression (Figure 1). For the socio-economic level, 20 items were considered by the principal components analysis. These 20 items are: the presence of bucket, bowls, cup, gas fireplace, bed, mattress, table, chair, functional radio, functional clock, functional lamp, functional television, functional bicycle, functional motorcycle, functional telephone, functional cart, functional wheelbarrow, donkey or horse, poultry, sheep or goat. For nutritional status, the index was calculated according to growth standards published by the World Health Organization (WHO) in 2010 [24]. Then the z-scores were grouped into 03 categories which are: Z-scores <-3 (severe malnutrition); -3=<Z-scores=<-2 (moderate malnutrition); Z-scores>-2 (Good nutritional status). Then we have recoded the nutritional status in two modalities: Malnourished/Normal children.

Six (06) variables were selected for the final model: Nutritional status, season of birth, twins, mother's age, household socio-economic status, vaccine status. For the season of birth, we took into account local realities. In the Central-North region,

the rainy season moved from June to October i.e.05 months against 7 months for the dry season. The specification of the model was made with the link test.

Ethical considerations

For ethical considerations, only identifiers were used for data analysis. Informed consent was requested from the mothers/ caretakers prior to data collection. The data collected was locked in cupboard and accessible only to the principal investigator. An application for a data collection authorization has been sent to health authorities in the Central-North Region. This research protocol has been submitted to the Ethics Committee for Health Research in Burkina Faso with a favorable opinion for the conduct of the research.

Results

A total of 104 deaths were included in the study with 2 controls (208) for each death.

Basic characteristics of the sample

- Household characteristics and maternal characteristics
- The socioeconomic status of households: 53.9% of the cases lived in rich households against 48.6% of the controls.
- Head of household education level: 29.8% of cases lived in households where the head of household had no level of education compared to 22% of the controls.
- The presence of latrines in the household: 35.6% of cases had latrines against 40% of controls.
- Age of mothers: The mean age of the mothers was 26.13 ± 6 years and 20.2% of the cases were born to mothers under the age of 20 compared to 10.6% of the controls.
- The level of education of mothers: 80.8% of cases were born to mothers with no education compared to 80.3% of the controls.
- The main source of household water: 79.8% of cases had a pump against 77.9% of controls.

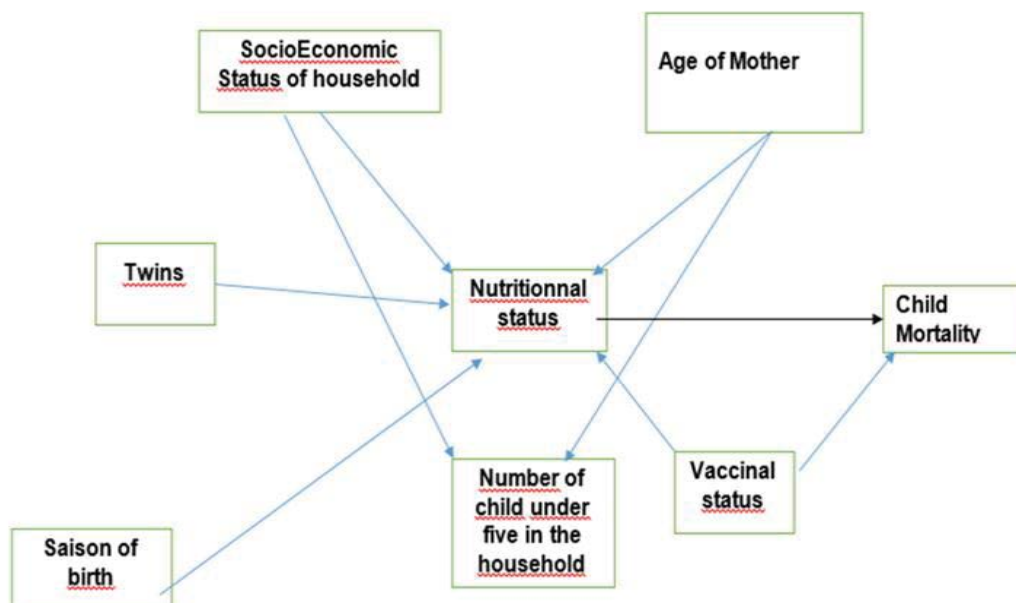


Figure 1. Casual diagram model of the relation between nutritional status and child mortality in the context of food supplementation.

- The number of children under 05 in the household: 29.8% of cases had more than 04 people in their household compared to 32.7% of the controls.
- Household size: 74% of the cases had more than 06 people in their household compared to 73.6% of the controls.

The characteristics of the child

- Nutritional status: 27.9% of cases were malnourished compared to 20.2% of controls.
- The twins: 9.6% of the cases were twins versus 2.9% of the controls.
- Morbidity at 06 months: 24% of cases had fever and/or diarrhea at 06 months against 32.7% of controls.
- Vaccination status: 13.5% of cases were up to date with vaccination at the age of 6 months against 11.5% of controls.
- The presence of little brother: 51.9% of the cases had a small / sibling compared to 40% of the controls.
- The season of birth: 91.3% of the cases were born during the rainy season against 96.6% of the controls.

Factors associated with death in univariate analysis

- In univariate analysis, the variables significantly associated with death were: twins and mother's age.
- Twins: Being twin was associated with death. The deceased children were 4.33 times more likely to be non-twins (OR=4.13, 95%CI=[1.33-14.02] and P=0.015).
- Age of mother: Being born to mothers aged 20 to 34 was associated with death. Children who died were 54% less likely to be born to mothers aged 20 to 34 compared to children born to mothers under 20 years of age. (OR=0.46, 95%CI=[0.23-0.91] and P=0.027).
- The birth season, socio-economic status, nutritional status was not associated with death (Table 1).

Factors associated with death in multivariate analysis

- In multivariate analysis the only factor associated with death was the age of the mothers.
- Being born to mothers aged 20 to 34 was associated with death. Children who died were 52% less likely to be born to mothers aged 20 to 34 compared to children born to mothers under 20 years of age. (OR=0.48, 95%CI=[0.23-0.99] and P=0.047).
- In multivariate analysis, the birth season, immunization status at 06 months and the nutritional status were not associated with death (Table 2).

Discussions

Limitations of the study

This is a matched case-control study nested in a cohort. The exhaustive number of cases identified during the study period was just 104 the number of cases needed to conduct our study against the set parameters. To increase the power of our study we chose 1 case for two witnesses. Despite the small size of our sample, the results show the factors associated with death in a

context of supplementation. We did not investigate the causes of child deaths. Also the nutritional status at the time of death is not known. Some information on the status of the child at birth was not included in the analyzes because more than 60% of the data were missing from the birth registries in the health facilities and after the deaths of the children the parents do not keep more notebooks. Despite these limitations, the design of our study (matched case-control study nested in a cohort) identifies the factors associated with the death of children in a context of food supplementation.

Nutritional status and death of children aged 6 to 24 months in the context of diet supplementation

In our study, univariate analysis and multivariate analysis, nutritional status was not associated with death. Univariate: (OR=0.68, 95% CI=[0.40-1.157], P-value=0.150) and

Table 1. Univariate analysis.

Category	OR brut	IC (95%)	P-value
Nutritional status			
Normal	1		-
Malnourished	0,68	[0,40-1,157]	0,150
Twins			
Yes	1		-
No	4,33	[1,33-14,02]	0,015
Vaccinal status at 06 month year			
Vaccine	1		-
Not vaccine	0,77	[0,32-1,82]	0,556
Socio-economic status of household			
Pover	1		-
Riche	1,21	[0,77-1,88]	0,407
Age of the mother			
Less of 20 years	1		-
20-34 years	0,46	[0,23-0,91]	0,027
More than 34 years	0,45	[0,17-1,14]	0,092
Season of birth			
Rainy	1		-
Dryer	2,79	[0,98-7,91]	0,054

Table 2. Multivariate analysis.

Category	OR adjust	IC (95%)	P-value
Nutritional status			
Normal	1		-
Malnourished	1,48	[0,86-2,53]	0,156
Socio-economic status			
Power	1		-
Rich	1,2	[0,75-1,93]	0,447
Age of the mother			
Less of 20 years	1		-
20-34 years	0,48	[0,23-0,99]	0,047
More than 34 years	0,46	[0,17-1,26]	0,132
Season of birth			
Rainy	1		-
Dryer	3,39	[1,06-10,77]	0,057
Twins			
Yes	1		-
No	4,33	[1,33-14,02]	0,015
Vaccinal status at 06 month year			
Vaccine	1		-
Not vaccine	0,77	[0,32-1,82]	0,556

multivariate (OR_{adj}=1.48, 95% CI=[0.86-2.53]; P-value=0.156). Malnutrition is the leading cause of child deaths. In a study on levels of malnutrition and risk factors for mortality in Harare Central Hospital-Zimbabwe, Chimhuya et al. showed that malnourished children were 2.6 times more likely to die than well-nourished children (OR=2.63; 95% CI=1.24-5.56) [25]. In 2017 in Iran, Gholam et al. showed that low birth weight was associated with children in rural areas [14]. Several other studies have found similar results [25-29]. Our results differ from those reported in the literature. Malnutrition reduces immunity and exposes children to acute infections. Thus to reduce the mortality in children under 05 years several interventions are implemented. The Vim project is part of these interventions. It focuses on nutrition education, supplementation and improving household incomes. In addition to this project in the north-central region, the Food and Agriculture Fund (FAO), the World Food Program (WFP) in partnership with the Kaya Health District (DSK), is screening malnourished children as soon as possible. The age of 06 followed by outpatient or hospital care depending on the level of severity. This difference in outcomes may be due to the effect of different interventions in the detection, control and management of malnourished children, thus improving their chance of reaching their second birthday.

Socioeconomic status and death of children

Socioeconomic status is not associated with the death of children in unified analysis and multivariate analysis. In univariate analysis: OR=1.21; 95% CI=[0.77-1.88]; P-value=0.407 and in multivariate analysis: OR_{adj}=1.2; 95% CI=[0.75-1.93]; P-value=0.447. In Nepal, a study of an observatory showed the role of the low socioeconomic level in the occurrence of deaths of children below five years of age [30]. Children born to poor households were more likely to die than children from rich households. Several other studies have shown this association between low levels of poverty and child deaths [31-35]. Our results differ from those reported by several authors. In 2017, Koffi et al. in Nigeria in a study on the socioeconomic determinants of mortality among children from 1 to 59 months showed that children who lived in the two poorest quintiles in households died more than those who lived in the wealthiest households. In Tanzania, in 2013, Nattey and collaborator found that the poorest died 2.4 times more than children born in the poorest households in a cross-sectional study that included 11,189 children under five living in 7,298 households in a surveillance system in 2005 [36]. A study conducted in a Nigerian observatory in 2015 [37], showed the low socioeconomic level of households was associated with the deaths of children under five.

This difference would be explained in this context of nutritional intervention by the fact that one more of the distribution of food, health and nutrition education messages is disseminated to all mothers of children. As a result, poor and rich alike have equal access to health care and disease prevention.

The birth season and the death of children before their second birthday

In both univariate and multivariate analysis, the birth season was not associated with the death of children. Becher et al. in a survival analysis showed that children born during the rainy

season were more likely to die than children born during the dry season (HR=1.21 and P=0.04) [37]. Our results, different from those reported by Becher, could be explained by the fact of food supplementation in the region. In addition, during the lean season, households receive a ration called "household ration" in addition to the ration for children as soon as they reach the age of 06 months.

Age of mothers at birth of children and death before their second birthday

In univariate, deceased children were 54% less likely to be born to mothers aged 20 to 34 compared to children born to mothers under 20 years of age (OR=0.46, 95% CI=[0.23-0.91] and P=0.027). In multivariate analysis the only factor associated with death was the age of the mothers. Being born to mothers aged 20 to 34 was associated with death. Children who died were 52% less likely to be born to mothers aged 20 to 34 compared to children born to mothers under 20 years of age (OR=0.48, 95% CI=[0.23-0.99] and P=0.047). In most studies, being born to mothers under the age of 20 was a factor associated with death [38-43]. Becher et al. also showed that mothers under the age of 18 were more likely to lose their child before the first birthday (RR=1.4 and 95% CI=[1.09-1.79]). Similar to those reported by Becher, several other authors have reported similar results; adolescents are less experienced in caring for children.

Conclusion

In this matched case-control study nested in a cohort of supplemented children with rural health and nutrition education, the factors associated with the death of children aged 6 to 24 months differ from the known factors associated with death outside the intervention of supplementation. The only factor associated with univariate and multivariate analysis in the model used was the age of the mothers. In univariate, deceased children were 54% less likely to be born to mothers aged 20 to 34 compared to children born to mothers under 20 years of age (OR=0.46, 95% CI=[0.23-0.91] and P=0.027). The nutritional status of children, socio-economic status, birth season, inter-reproductive space, and twins are not associated with the death of children in a context of nutritional intervention. Supplementation would therefore reduce the deaths of children from poor households and malnourished children.

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Franck Garanet designed, performed, and analyzed the content; and all authors wrote the paper. All authors read and approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflicts of interest with the contents of this article.

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